STATION PAPER NO. 105 • NORTHEASTERN FOREST EXPERIMENT STATION • 1958
FOREST SERVICE • U.S. DEPARTMENT OF AGRICULTURE • UPPER DARBY, PA.
RALPH W. MARQUIS, DIRECTOR

Some Recent Developments in White-Pine Weevil Research in the Northeast

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A paper presented at the annual meeting of the Entomological Society of America at Memphis, Tennessee, December 1957.

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EASTERN white pine is one of the most important saw-timber species in the Northeast. This species would have still greater potential value were it not for the white-pine weevil, *Pissodes strobi* (Peck), its most serious insect pest. This is a native insect that occurs throughout the range of eastern white pine. A large percentage of the white pines in natural stands and plantations have been attacked once or more; and the crooks or forks that result from attack greatly reduce the quality and quantity of timber that such stands produce.

The size of the loss in merchantable volume of standing white pine caused by the white-pine weevil was revealed in a study made in New Hampshire *(6)*. The average volume

loss was 13 percent in pole-size trees (5 to 8.9 inches d.b.h.), 40 percent in the sawlog portion (board-foot volume) of sawtimber trees (9 inches d.b.h. and over) and 70 percent in the portion above sawlog limits of merchantability (cubic volume).

White pine is not the only tree species attacked. Norway spruce plantations have been severely attacked by the weevil in the East, and jack pine plantations in the Lake States are also vulnerable. The weevil attacks all conifer trees except balsam fir and hemlock.

THE OBJECTIVE of our research program is to develop efficient methods of reducing losses of white pine due to the weevil. Although a great deal of valuable research has been done, many questions remain unanswered.

U.S. Forest Service research on the white-pine weevil has taken several courses. We are seeking more information about the insect itself. We are seeking more effective methods of control by spraying. We are also studying the tree species itself in its relationship to the insect.

The time in the spring when weevils emerge is an important factor in control. Godwin and Bean *(3)* have shown that there is a close correlation between emergence and average and maximum daily temperatures, and that weevil emergence can be predicted by using cumulative degree-hours above 40° F. A reasonably accurate estimate can be made of the degree and rate of weevil emergence in the spring. With this information, better spray treatments can be devised. This timing of spray applications is particularly important

for spray materials that have a brief residual effect.

The distances weevils may fly is very important when considering the degree of isolation required for small experimental spray plots, and also for large control operations. Barnes *(1)* has done considerable work on the flight habits of the weevil. To get more specific information on dispersal we tried tagging weevils with radioactive isotopes. We released 1,600 weevils tagged with Scandium-46 in September in a small plantation and traced them the following spring *(4)*. While the lengths of individual flights were not measurable, the distinct stratification suggested that weevil movement of 300 to 400 feet was the result of direct uninterrupted flight from the release trees.

We feel that still further studies should be made of weevil dispersion. If weevils could be tagged in the spring, there would not be the loss of treated weevils during the winter. Present plans are to use Scandium-46 again but at a lower specific activity than was used in the fall, and to tag some 3,000 to 4,000 weevils for release in a large plantation in the spring.

WE ARE also studying egg-laying habits. It has been reported that the weevils issuing in August do not mate until the following spring, and that insemination does not take place in the fall. In laboratory tests, 84 percent of the females isolated from male weevils in early November produced viable eggs in the spring.

To determine to what extent fall insemination occurs in the field, female weevils were collected in early October and were immediately placed in an overwintering cage by

themselves. Thirty-four percent of these females laid viable eggs the next spring, which indicates that fall insemination is high. The fact that many females are ready and able to oviposit immediately after emergence in the spring without further mating is important in the timing of sprays.

We are also studying various physical aspects of the tree such as the effect of bark thickness and leader diameter in relation to oviposition. To determine the possible existence of racial differences in eastern white pine to weevil resistance, an experimental planting of white pine trees from 12 different sources has been made. In this connection it will be necessary to study the effect of the various oleoresins, auxins, etc., on the insect, which means we need to know considerable about the chemistry and physiology of the tree and the physiology of the adult weevil.

EXPERIMENTS and control projects since 1939 have proved conclusively that the white-pine weevil can be controlled to a height of 16 feet by using a knapsack sprayer with concentrated lead arsenate spray (2). Spraying with lead arsenate can be done at any time from December until the buds start to expand about May 1. The upper half of each leader should be sprayed to the runoff point.

The knapsack-sprayer technique has now been used with excellent results for a number of the newer insecticides. The following materials and strengths may be depended upon to control the white-pine weevil when applied in late March or early April. Control in this case means that less than ½ percent of the trees become weeviled.

1. Lindane emulsion ½ percent plus Aroclor 5460.
2. Heptachlor emulsion 2 percent.
3. Heptachlor emulsion 1 percent plus Aroclor 5460.
4. Endrin emulsion 1 percent plus Aroclor 5460.
5. Malathion emulsion 2 percent plus Aroclor 5460.
6. DDT emulsion 2 percent.

With at least one of these materials, weevil control is now possible with fall applications. On October 24 and 25, 1956, three blocks of trees were sprayed with 2-, 1-, and ½-percent Lindane emulsion, with the addition of like percentages of Aroclor 5460, replicated three times. In 1957 only 1 tree out of the 10,000 trees sprayed was weeviled.

SPRAYING large plantations with a helicopter has given very good control. The most satisfactory results were obtained when a solution or emulsion containing 2 pounds of DDT in 2 gallons of liquid per acre was applied in the spring.

Spraying with fixed-wing aircraft has not been so satisfactory. However, with some of the newer materials, both types of aircraft may give good control with a smaller amount of insecticide and liquid per acre.

Preliminary tests of a 2-percent granular formulation of Endrin gave promising results for the control of hibernating weevils at a rate of 1 pound Endrin per acre *(5)*. Last winter several additional materials at rates ranging from 1 pound active ingredient per acre to ¼ pound per acre confirmed the promising results obtained earlier. Two materials, Aldrin and Heptachlor, resulted in no emergence of

caged weevils in treated areas at ½ and ¼ pounds per acre of active ingredient. A larger scale test utilizing ¼-acre plots was conducted this fall (1957), using Aldrin and Heptachlor at these two rates.

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